

21. CONCLUSIONS FROM EXPERIMENTS ON BABOONS.
(E. B. P.)

Some of the most interesting results were those which show the actual working of the principle on which the theory of mimicry depends; especially the twice-repeated experiment with the exposed under-side of the distasteful *Acræa anemosa*, resulting in the escape of the *Precis sesamius* ⊕ with a somewhat similar under-side, while the same species deprived of its wings was readily eaten. At the same time a *P. sesamius* ⊕ was on one occasion rejected by the female without any preparatory display of an *Acræa*. The suspicion of the Lycoid Longicorn, *Blepisanis haroldi*, dispelled when it was tasted, points in the same direction. On the other hand, the baboons were not imposed upon by the resemblance of the Carabid *Polyhirma anigma* to a *Mutilla*. In the natural state the swiftly-running Carabid would have a much better chance of this pseudoposematic protection than under the conditions of an experiment with captive insect-eaters. *Byblia ilithyia* was similarly distinguished from an *Acræa*; but this by no means proves that the resemblance is not beneficial under natural conditions.

As regards Lepidoptera, the refusal of a *Protoparce convolvuli*, after examination of every fragment of it, is most remarkable. The insect at rest is apparently a beautiful example of cryptic colouring. Further experiments are very desirable.

The *Acræina* (*acina*, *caldarena*, *rahira*, *anemosa*, *halali*) and *L. chrysippus* were never eaten, although sometimes tasted; on many occasions they were recognized at sight, and refused. *Mylothris agathina* was sometimes partly and once completely eaten, but it was usually rejected and evidently unpalatable to them. *Neptis agatha* was also generally tasted and neglected, and never entirely eaten. The Pierine *Herpania eriphia* was also evidently distasteful. Other butterflies which were usually eaten did not appear to be a food which is much appreciated. Thus *B. ilithyia* was sometimes neglected and sometimes only partially eaten; *Teracolus achine* was on one occasion eaten "with doubt," and the same was true of one *Papilio corintheus*. The two large Hesperids of the genus *Rhopalocamptu* were, on the other hand, eaten with relish, and the baboon showed evident disappointment on receiving *Belenois*

mesentina after them. Apart from these examples of hesitation, disappointment, and refusal in part or complete, the baboons ate many species of *Pierinae* (*Teracolus*, *Colias*, *Terias*, *Belenois*, *Catopsilia*) and *Nymphalinae* (*Junonia*, *Precis*, *Pyrameis*, *Atella*, *Hypolimnas*), but refused to touch the larva of *Precis sesamus*. Considering what has been already argued about insect-eating animals in confinement, the acceptances (excluding the *Hesperidae*) probably do not justify the conclusion that the Lepidoptera were palatable, or that they would be sought for in the wild state except under the stress of hunger. The treatment of the larva of *Belenois mesentina* certainly seems to indicate palatability to the baboon, and also that it was a first experience of this caterpillar.

The experiments with Hymenoptera are particularly valuable; for although *Mutillidae* and *Braconidae* are so greatly mimicked, there is practically no direct evidence that they are refused by insect-eaters.

The fact that the two large species of Hemiptera were eaten, in one case "with great avidity," is a further example of the failure of a mode of defence which produces a great impression upon man, viz. the emission of an odour offensive to us. The suspicion created by the conspicuous spiders was probably due to unpleasant experiences of insects with a similar combination of colours.

The numerous experiments with Coleoptera are exceptionally interesting. I have below tabulated the results under A, acceptances, and B, rejections. It is seen that the species of the following groups were refused without any exceptions:—*Lycidae*, *Melyridae*, *Cantharidae*, *Coccinellidae*, and *Scarabeidae*, while those belonging to the *Rutelidae*, *Buprestidae*, and *Curculionidae* were invariably accepted. The uniform refusal of five species of Scarabeids is somewhat surprising, but all of them possessed iridescent colours. Of the six *Cetoniidae* offered, four were always refused, two being sometimes rejected and sometimes eaten. The only Phytophaga eaten were two *Clythridae* of the genus *Peploptera*, and one of these was refused at first. The cryptic Heteromera were accepted, although one of them was smelt and refused on one occasion; the iridescent species was rejected. Longicornia were eaten, except the Cantharid-like *Ceroplesis*, which is probably synaposematic (compare p. 396). The *Carubidae* were extremely interesting. The acid secretion appears to be their

undoubted defence against baboons as it was against the kestrels (pp. 342-3). Hence the small and medium-sized species were eaten somewhat freely, although with evidence from time to time that the acid was disliked, and, on the other hand, a large species with a greater amount of secretion was avoided, and evidently recognized at sight. Another one being seized, discharged its secretion into the baboon's mouth with immense effect. When however it was killed and offered piecemeal, all the parts except those which contained the acid were eaten by the other baboon. If we allow for the fact that *Carabidae*, attacked under natural conditions, have a much larger supply of the acid, we must admit that they possess a very powerful defence, and that the meaning of the chief quality which underlies the aposematic appearance of the large species is tolerably clear.

A.—*Colcoptera* accepted by Baboons.

| GROUP. | SPECIES. | SIZE AND APPEARANCE. |
|---------------|---|---|
| CARABIDÆ. | <i>Pezia marshalli</i> . | Medium; black with white lines and patches. |
| | „ <i>selousi</i> (sometimes treated as if distasteful and only partly eaten). | Largish; similar coloration to above. |
| | <i>Polyhirma ninyma</i> (with doubt at first). | Smallish; black, white-spotted. |
| | <i>Polyhirma boucardi</i> . | Largish; black with white dorsal thoracic line. |
| | <i>Polyhirma semisuturalis</i> . | Medium; black with white lines and patches. |
| | <i>Graphipterus mashunus</i> . | Smallish; black with tawny lines and spots. |
| | <i>Graphipterus tibialis</i> . | Small; grey-brown, with grey linear markings. |
| | <i>Chlaniuscylindricollis</i> . | Medium: green, with yellow margin to elytra and yellow legs. |
| RUTELIDÆ. | <i>Anomala</i> , sp. nov. | Medium; testaceous. |
| | <i>Adoretus flavicollis</i> . | Smallish; „ |
| BUPRESTIDÆ. | All <i>Psiloptera</i> (including the largish <i>P. chalcophoroides</i>). | Cryptic colouring. |
| | <i>Sternocera funebris</i> . | Large; shiny black, with white hairs on thorax. |
| CURCULIONIDÆ. | <i>Brachycerus brevicostatus</i> . | Large; cryptic. |
| | <i>Polyceis longicornis</i> . | Largish; black, with yellow spots on elytra. |
| | „ <i>equestris</i> , var. | Largish; iridescent blue-green with red oblique band on elytra. |

| GROUP. | SPECIES. | SIZE AND APPEARANCE. |
|--------------|--|---|
| HETEROMERA. | <i>Psammodes scabratus.</i> | Large; cryptic. |
| | <i>Anomalipus plebeius</i> (once refused after smelling). | Large; black, often earthy, and probably allocryptic. |
| | <i>Micrantercus carinatus.</i> | Medium; probably earthy and allocryptic female, shining black male. |
| PHYTOPHAGA. | <i>Peploptera anchoralis</i> (rejected at first). | Medium; yellow with black spots and bands (<i>Clythrida</i>). |
| | <i>Peploptera zambesiana.</i> | Similar to above. |
| LONGICORNIA. | <i>Trayischoschema wahlbergi.</i> | Smallish; black with conspicuous orange markings. |
| | <i>Blepisanis haroldi.</i> | Small; Lycoid. |

B.—*Colcoptera rejected by Baboons.*

| GROUP. | SPECIES. | SIZE AND APPEARANCE. |
|---------------|--|--|
| LYCIDÆ. | Four species. | Warning coloration characteristic of African <i>Lycidæ</i> . |
| MELYRIDÆ. | <i>Prionocerus dimidiatus.</i> | Lycoid coloration. |
| CANTHARIDÆ. | <i>Zonitis</i> sp. | Characteristic Cantharid and Lycoid (<i>e. g. M. palliata</i> , etc.) coloration, orange and black. |
| | <i>Eletica rufa.</i> | |
| | <i>Decatomia lunata.</i> | |
| | „ <i>tettensis.</i> | |
| | „ <i>divincta.</i> | |
| COCCINELLIDÆ. | <i>Chilomenes lunata.</i> | Characteristic Coccinellid coloration. |
| | <i>Epilachna dreggi.</i> | |
| | <i>Malacosoma discoidealis.</i> | Medium; nearly black with narrow yellow band at apex, and at base of elytra. |
| PHYTOPHAGA. | <i>Diacantha conifera.</i> | Lycoid coloration. |
| | <i>Plagioderia thoracica.</i> | Largish; red-brown thorax, iridescent blue or green elytra. |
| | <i>Clythra wahlbergi.</i> | Medium; Cantharid type, orange and black. |
| | <i>Clinteria infuscata.</i> | Medium; brown elytra, sometimes black, orange thorax with two black spots. |
| CETONIDÆ. | <i>Pachnoda flaviventris.</i> | Large; greenish-black with orange markings. |
| | „ <i>rufa.</i> | Large; thorax green, greenish-orange elytra. |
| | <i>Protatia amakosa</i> (sometimes eaten). | Smallish; black with many small white spots. |
| | <i>Orythyrea dysenterica</i> (sometimes eaten). | Smallish; shining green or blue elytra and red thorax. |
| | <i>Coelorrhina loricata.</i> | Largish; green thorax and scutellum, yellow elytra with 4 black spots; brick-red head and legs. |
| SCARABÆIDÆ. | <i>Onitis inuus.</i> | Largish; iridescent dark-green. |

| GROUP. | SPECIES. | SIZE AND APPEARANCE. |
|--------------|--|---|
| SCARABÆIDÆ. | <i>Onitis albicis.</i> | Medium ; brown elytra and legs, iridescent green thorax and head. |
| | <i>Onthophagus gazella.</i> | Smallish ; similar colouring to above. |
| | <i>Gymnopleurus smaragdinus.</i> | Small ; iridescent green, blue, or red. |
| | <i>Oniticeilus militaris.</i> | Small ; probably when fresh iridescent dark-green with orange markings. |
| HETEROMERA. | <i>Praogenia festiva.</i> | Medium ; almost black with purplish iridescent reflections on elytra, bluish on thorax. |
| CARABIDÆ. | <i>Anthia thoracica.</i> | Large ; black, white spot on thorax and white margin to elytra. Huge mandibles. |
| | „ <i>massilicata</i> (only eaten when offered piecemeal). | Large ; black with pale margin to elytra. Huge mandibles. |
| LONGICORNIA. | <i>Ceropopsis fallax.</i> | Large ; black, yellow-banded, Cantharid type. |

22. THE CHIEF CONSPICUOUS SPECIALLY-DEFENDED GROUPS IN THE COLEOPTERA INFERRED FROM G. A. K. MARSHALL'S EXPERIMENTS. A COMPARISON BETWEEN COLEOPTERA AND LEPIDOPTERA IN THIS RESPECT. (E. B. P.)

It is of great interest to attempt to conclude from the results of the experiments on the palatability of conspicuous Coleoptera contained in this memoir, and from previously recorded observations and experiments on the same order of insects, what are the chief specially defended groups which may be considered to stand in the same position towards their allies as the *Ithomiinæ*, *Danainæ*, *Heliconinæ* and *Acravinæ* do to the rest of the Rhopalocera, and the *Agaristidæ*, *Syntomidæ*, *Zygænidæ*, etc., do to the rest of the Heterocera.

The chief memoirs upon which the conclusions stated below have been based are published in the Transactions of the Entomological Society of London. They are the papers by Mr. C. J. Gahan (1891, p. 367), by Mr. H. Donisthorpe (1901, p. 345), and the Presidential Address of Canon W. W. Fowler, Jan. 15, 1902 (Proc. 1901, p. xxxiii). I have also had the opportunity of reading the manuscript of an important paper by Mr. R. Shelford on mimicry in Bornean insects, now being published by the Zoological